Space Weather Technical Forecast

Issued on Friday, 23 August 2024 at 13:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further R1/R2 flares likely, slight chance of isolated R3 flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate, with two M-class flares recorded in the last 24 hours, the peak being an M3.4 flare from AR3801 at 23/0341UTC.

There are currently eleven sunspot regions on the visible disc, with two new regions as yet unnumbered. The largest and most complex regions on the disc are AR3790 (Dhc/Beta-Gamma) and AR3796 (Dhi/Beta-Gamma). Both of these regions have seen some recent penumbral growth around intermediate spots, and both are showing signs of a weak delta spot formation. Both AR3799 and AR3801 in the eastern hemisphere continue to rotate further into view, although classification remains tricky due to foreshortening effects. AR3801 has been the most active region, with the largest flare of the period as mentioned above. AR3800 in the southeast has seen a number of intermediate spots quickly forming over the past few hours. The remaining sunspot regions are comparatively smaller or less complex, and mostly either stable or in slight decay.

Two CMEs were observed through the period. One was as a result of a filament lift-off from near to AR3794 at around 23/0100UTC, as well as a long-period C5.6 flare from the same region. Initial analysis suggests that this will pass ahead of Earths orbit. The second CME observed was as a result of the M3.5 flare from AR3801, but this is expected to pass behind Earth's orbit, pending analysis.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, was generally at background levels but with a brief rising trend to around 400km/s during the late UTC evening of 23 Aug. The density was initially at average or above average levels, peaking near 19ppcc around 22/1800UTC, before declining to mostly below average levels. The Interplanetary Magnetic Field (IMF), Bt, was at weak to moderate levels, varying between 2-11nT. The north-south component, Bz, was mostly weak and positive, but did become moderately negative at times, varying between +8 and -10nT. The phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels.

High energy electron flux (greater than 2MeV) observed at GOES16 was at generally background levels. The 24-hour fluence was below the Active threshold, with 9.32e5 integrated pfu observed at 23/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-class flares are likely during the period with a slight chance of isolated

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X-flares.

Solar Wind /Geomagnetic Activity: Two CMEs observed in the past 24 hours are expected to miss Earth, pending further analysis.

Two high speed streams (HSS) from coronal holes CH60/+ and CH61/+ in the northwest are likely to exert some weak influence through Day 1 (23 Aug) and perhaps into Day 2 (24 Aug). Solar winds may increase further towards slightly elevated or possibly elevated levels, 400-500km/s, with any HSS influence then expected to wane thereafter.

Geomagnetic conditions are expected to be largely Quiet to Unsettled (Kp1-3), but with a slight chance of isolated Active to G1/Minor Storm intervals (Kp4-5) intervals on Days 1 and 2 (23-24 Aug), should we see any more significant coronal hole influence.

Energetic Particles / Solar Radiation: High energy proton flux is likely to remain at background levels, with a chance of exceeding the S1/Minor solar radiation storm level should any notable flares occur.

High energy electron flux is expected to remain at largely background levels. The associated 24-hour fluence is expected to be below the Active level but with a rising trend likely later in the period.

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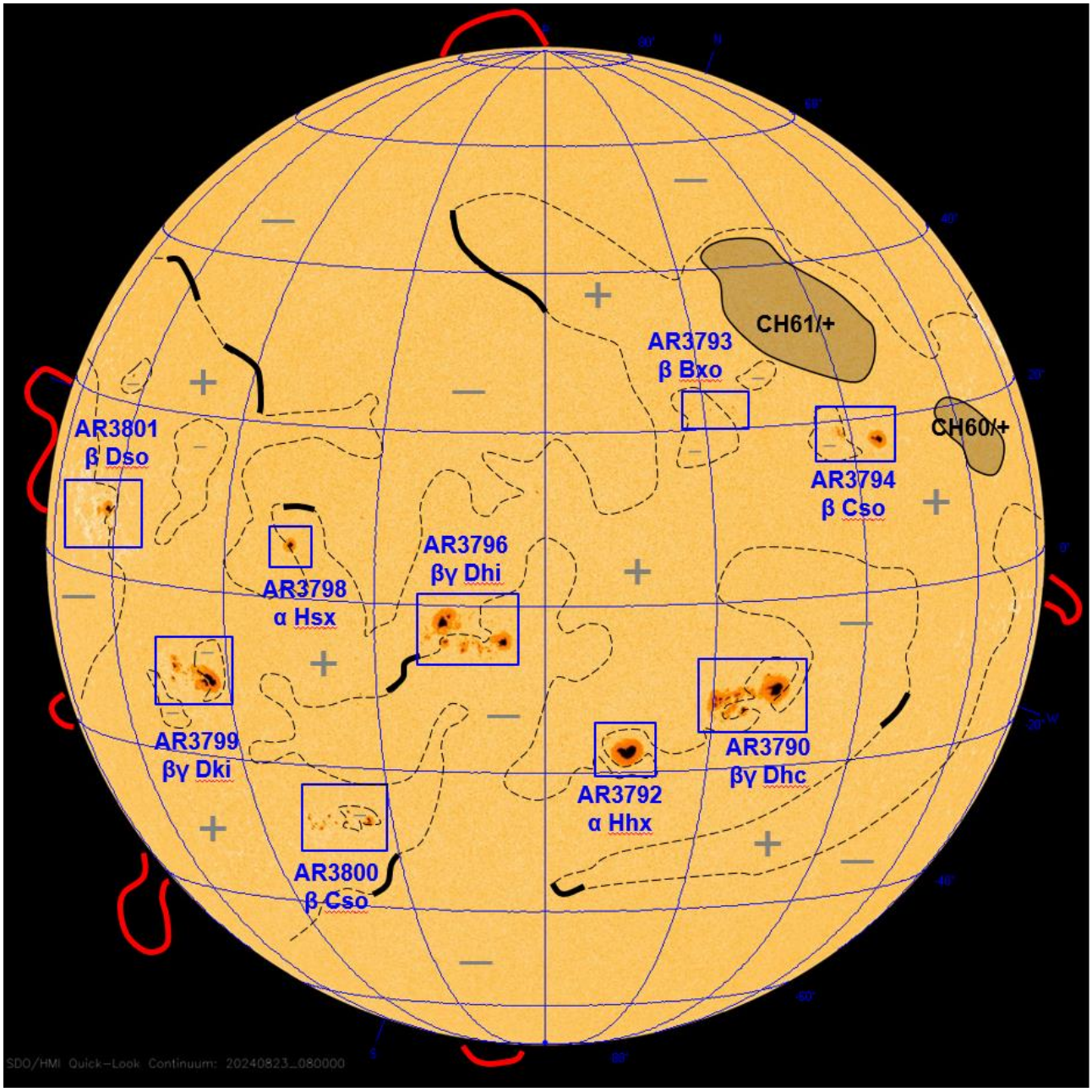
Figure 1. Solar Analysis Valid 23/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME has been observed in coronagraph imagery as a result of a filament liftoff from close to AR3794 at around 23/0100UTC, as well as a subsequent long-period C5.6 flare from the same region. An associated Type II radio emission of 236km/s was also observed. Given its location, there is a possibility of an Earth-directed component, however initial analysis suggests it will miss ahead of Earths orbit.

The main focus of the forecast will be regarding weak high speed stream influences over the next day or so. A slight rise in solar wind speeds late on 22 Aug UTC may have been as a result of CH60/+, with further influence from this, as well as CH61/+ slightly further north, likely. These effects are expected through Day 1 (23 Aug) and perhaps lingering into Day 2 (24 Aug). Solar winds may increase again towards slightly elevated or possibly elevated levels, 400-500km/s, with any HSS influence then expected to wane thereafter.

Geomagnetic conditions are expected to be largely Quiet to Unsettled (Kp1-3), but with a slight chance of isolated Active to G1/Minor Storm intervals (Kp4-5) intervals on Days 1 and 2 (23-24 Aug), should we see any more significant coronal hole influence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	15	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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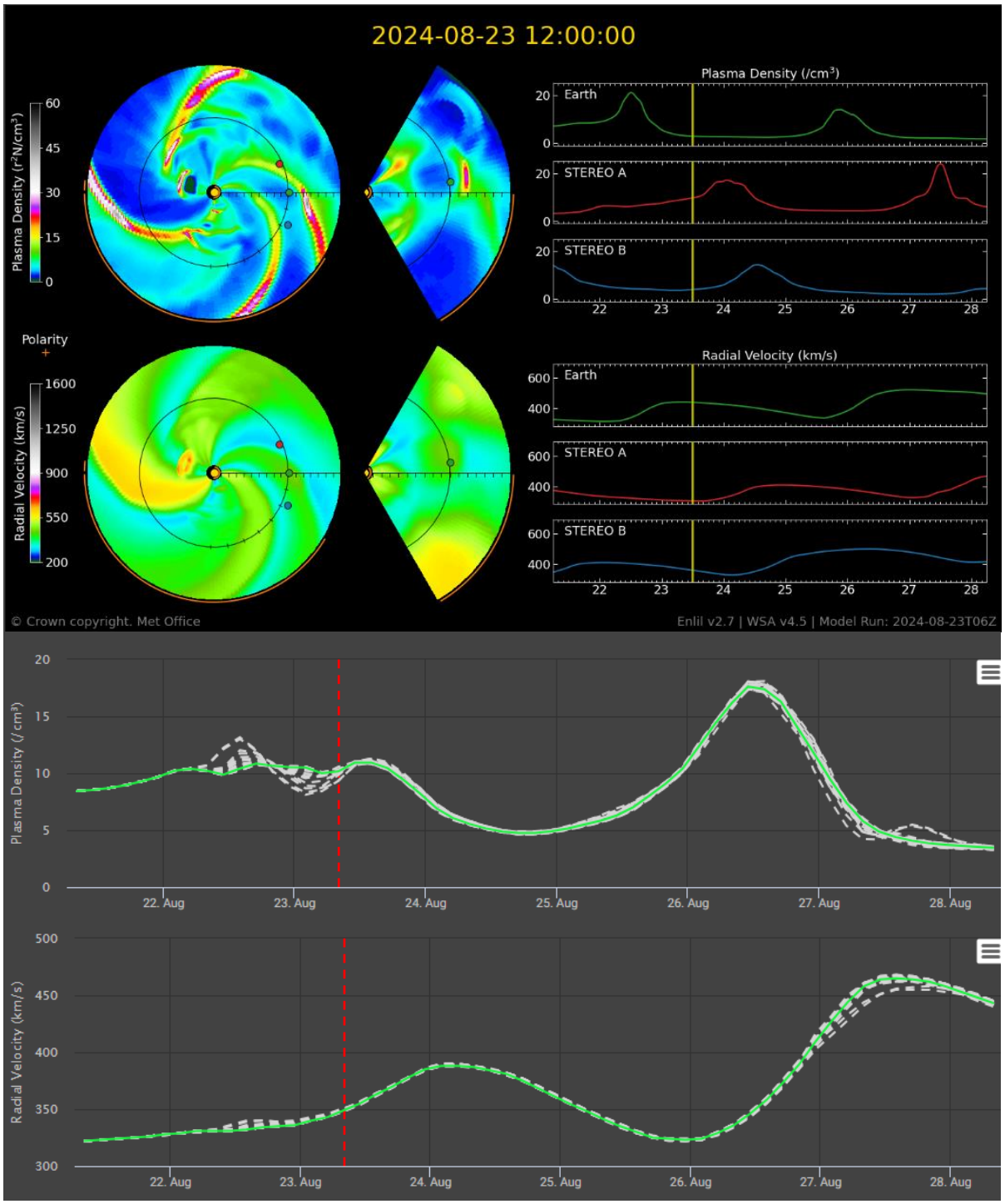
Figure 2: MOSWOC Enlil and Ensemble models



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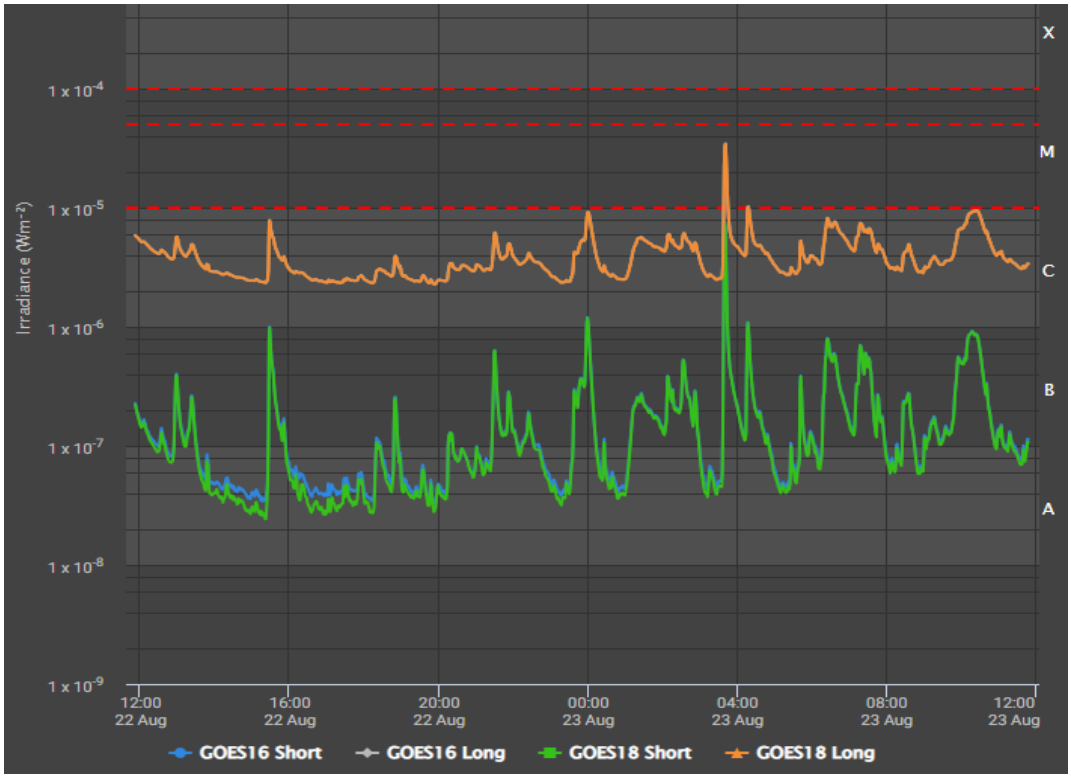
Radio Blackouts - X-Ray Flares:
Further M-class flares are likely given the number and complexity of active regions on the disc, with a slight chance of isolated X-class flares. The bulk of the flare risk originating now from larger regions AR3790 and AR3796, as well as AR3801 and AR3799, both in the east, which have been the most active regions over the past 12 hours. Currently no significant new regions are signaled to arrive over the eastern horizon from far-side soundings or persistence.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: GOES-16 & -18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux at GOES18 is likely to persist at background levels, but with a chance of rising in response to any notable flares.

Ex-AR3784 beyond the western limb is still the main region of interest for proton flux risk at present, but this risk slowly reducing once it gets well past the limb later in this period. However, AR3790, and increasingly AR3796, are rotating onto the western disc, with a gradually increasing risk of proton events from these features which will largely balance the reducing ex-AR3784, resulting in a generally steady risk.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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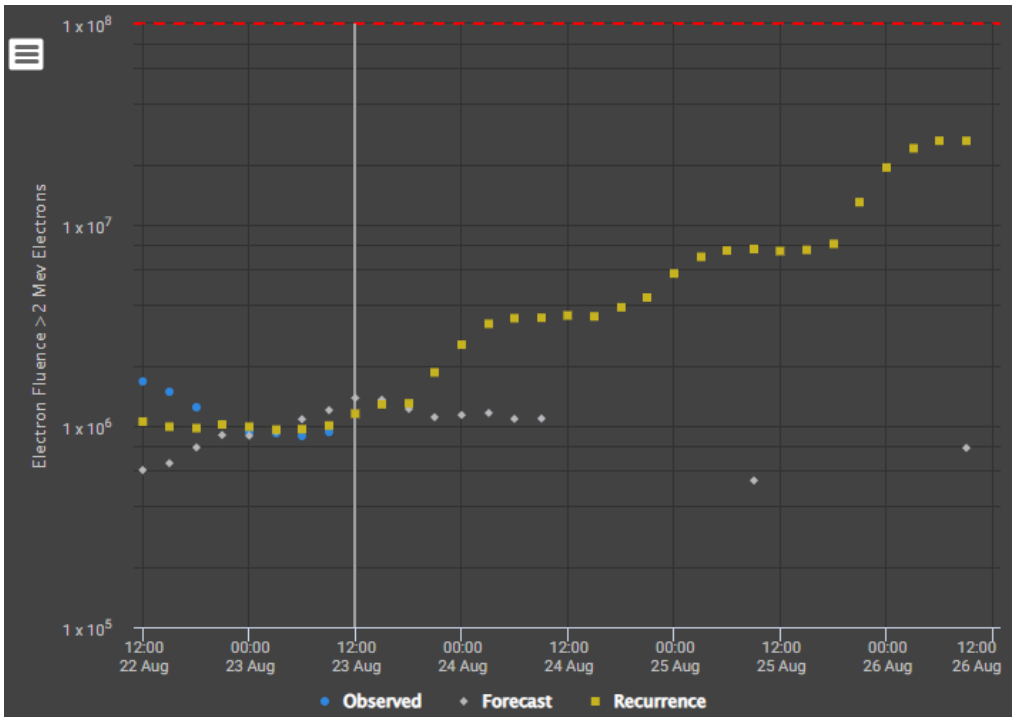
High Energy Electrons Event (≥ 2MeV):

Current predominantly background electron flux levels are considered likely to continue albeit with a likely rising trend due to potential HSS (High Speed Stream) influence, with an increase to near high diurnal levels possible later in the period.

Fluence is expected to remain below the Active (1e8 integrated pfu) threshold through the period but with a rising trend later. MOSWOC REFM looks to be providing reasonable guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM providing a reasonable quide.



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